

## **NIST Second Quarter Progress Report Home Smoke Alarm Research Project**

### **Progress on Tasks Planned for the Second Quarter**

There were four tasks scheduled during the second quarter of the project. The status of each is discussed below:

#### **5. Perform modeling studies of sites Months 3-6**

Modern fire models can provide valuable insights into the development of fires in the test spaces. The NIST model, FDS will be used to examine test arrangements and fire scenarios in advance of the experiments to provide information useful for instrument selection and location. After the completion of experiments model runs can be used to extrapolate results to untested conditions. Both such uses will be made.  
\$90k

Some initial modeling using CFAST and FDS has been performed to evaluate fuel characteristics necessary to activate smoke alarms and reach untenable conditions in the test homes without risking serious damage to the structures themselves. To date these studies have used the geometry data on the manufactured home as this is the only site for which we have floorplans and dimensions. An estimated floorplan of the candidate home in North Carolina was drafted and some preliminary models run, but detailed simulations must await confirmation of the availability of the home and preparation of proper floorplans.

#### **6. Develop instrumentation and test plans for sites Months 3-6**

Instrumentation layout, sensor locations, and measurement types need to be selected based on the scenarios planned and the floorplan of the site. These will be developed with the assistance of the modeling discussed in task 5 and the scenario list from task 4.  
\$50k

As with Task 5 above, detailed instrument and sensor locations have been completed for the manufactured home (see typical drawing in Appendix A) but await confirmation and floorplans for the North Carolina site. The test matrix for both sites has been completed (under Task 4) and is attached as Appendix B. We are currently planning 21 tests in the manufactured home and 12 (including one spare) in North Carolina. The test scenarios were selected based on John Hall's NFIRS analysis of fatal residential fires. The scenarios, including ignition type, first item ignited and room of origin, represent the top scenarios for fire starts (and fatal fires). The problem of (low) velocity measurement has been solved with the identification of a commercial, ultrasonic (2D) velocity probe that has been ordered. Evaluation of a sample in the FE/DE demonstrated that the probe can provide data below 1 m/s (resolution .01 m/s) in a hot, sooty environment.

#### 7. Identify and acquire fuel items

Months 3-6

The primary fuel items for the tests will be furniture and other household goods and these need to be representative of current materials and constructions. Some inexpensive items may be purchased new, but furniture items will be purchased used from residential furniture rental outlets. For the scenarios and floorplans of sites the appropriate items will be identified and procured. For field testing items will be procured locally to avoid shipping costs.

\$50k

Based on the scenarios and test plans we have identified a residential mattress and chair to serve as the primary fuels. The mattress is a twin size, pillow top design that will allow for the smoldering tests. The upholstered chair is a cotton over polyurethane design that is of sufficient mass to produce a peak HRR of 0.5 to 0.75 Mw. New items were selected because the cost was reasonable and we were able to procure the required number of identical items. We have constructed a smoldering igniter from a nichrome wire loop on a ceramic insulator powered from a vairac (see Appendix C). This igniter was used in some Australian tests in a similar fashion. Initial testing was conducted to determine an ignition location and procedure to obtain reproducible results. Sufficient chairs and mattresses have been ordered to provide for all tests with several spares.

#### 8. Construct long term test site

Months 3-6

Some testing may be conducted in an arrangement of rooms within the NIST test facility and others may be conducted in a manufactured home at the NIST site. The former needs to be constructed and the latter modified to allow fire testing without risking the unit.

\$65k

Currently, plans include the manufactured home already delivered and the North Carolina site awaiting vacating by the prior owners. Should a collaboration with the Sublethal Toxicity Project be confirmed the hardened site identical to the manufactured home but capable of withstanding multiple flashovers will begin construction, paid for by the other project. This decision will be made in the next two weeks. The remaining funds in this task will cover the costs of preparing the manufactured home for testing.

### **Continuing work on Tasks 1-4**

#### 2. Identify potential dwellings for test sites

Months 1-3

Test sites must be typical of US housing and represent single- and multi-family units, apartments and condominiums, and manufactured homes. Test sites will be selected from donated homes scheduled for demolition or rehab, purchased units, or simulated arrangements of rooms. Potential sites will be identified and evaluated by NIST staff and selections made in the interest of the overall project goals.

\$25k

A donated home in Kinston NC has been identified and offered for our use. It is a two-story brick home of about 900 sq ft per floor, with forced air heat pump HVAC. Current status is that it is occupied and the owners have agreed to sell the home to FEMA. Once they go to closing the occupants will have 90 days to vacate. We will look for a single-story home for tests in Spring 2002.

Below are front, side, and rear views of the Kinston home. Note the attached garage that will provide a secure location for testing logistics and equipment. The site is approximately 300 miles south of Washington DC along I95.





1. Acquire test detectors/alarms and conduct detector characterization.

Months 1-3

The NIST project staff will meet with smoke alarm manufacturers and develop a set of test articles that are representative of the range of products currently sold. Appropriate modifications may be made to the test articles to facilitate the acquisition of useful data but any modified articles will be calibrated against unmodified devices to assure representativeness. All test articles will be initially characterized in NIST's FE/DE apparatus to provide baseline data. Test articles exposed to fire tests will be re-checked in the FE/DE between field trials to assure that such exposure did not alter the operational characteristics.

\$95k

All planned test articles have been received except for the aspirated, commercial detector and most characterization work in the FE/DE has been completed. All test articles will be ready for use by the planned test start dates in April. So far, sample repeatability is good and analog data can be obtained without problem. While we have some spare analog sensors we must be careful about heat damage in flaming tests. In some cases we will use non-modified samples of the identical units in the room of origin to obtain alarm times or devise some method of protecting units when conditions become damaging.

A public meeting at NIST (Building 205) is being planned. CPSC has mailed 124 invitations to former participants in the "round table" meetings of 1999 and 2000. We will meet in Bldg 205 so that a tour of the instrumented manufactured home can be included. This will give attendees a good idea of the techniques that will be used in the experiments. No actual test will be run for safety reasons. There will be an opportunity for members of the steering committee to visit the North Carolina site if they choose, but no other visitors will be allowed, again for safety reasons and to optimize precious time in the field. One test day will be selected for these visits so as to not impact the testing schedule. Appendix A

## Instrumentation and Sensor Locations for Bedroom Fires

## Mattress Fire in the Bedroom



